

Scraper Chain Conveyor

Material Handling Machines

Operation

A continuous chain with transverse scrapers moves through a closed rectangular section trough over a horizontal, sloping, vertical, or mixed route. The lower length of the chain conveys the product along the bottom of the trough.

Purpose

This Application Bulletin provides information about Scraper Chain Conveyors, which can transfer granular or aggregate product at full rate over a distance that may include a level change while protecting the transported material from the weather. Scraper chain conveyors can be used for cooling or dehydrating product during transfer (through air or water circulation), mixing and measuring, bulk handling for storage, process supplying, extracting, distributing at several points, picking up product, and lifting decanted or washed product.

Examples of Use

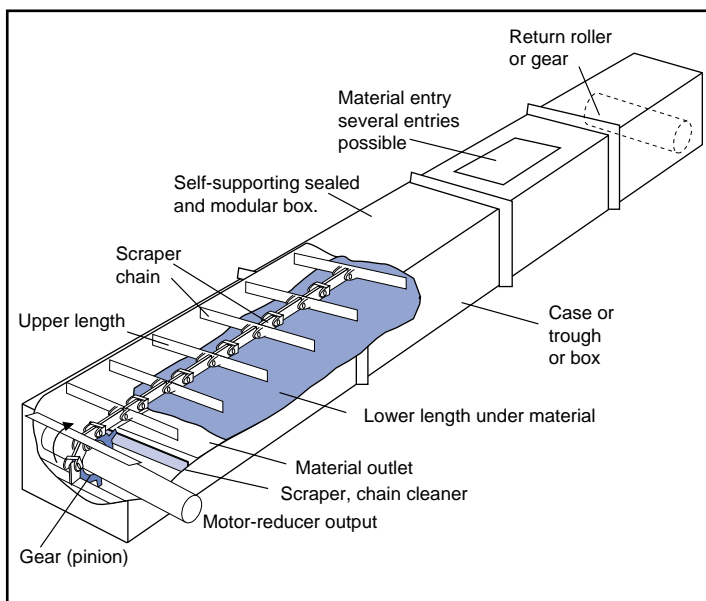
- Process supplying
- Evacuating waste
- Extracting beneath hopper
- Handling ash in incineration plants
- Handling coal in mines
- Caning sugar
- Bundling old paper in paper mills
- Dehydrating rubber
- Recovering sludge in water treatment stations
- Transferring wood chips in incineration plants
- Loading fertilizer

Names

Machines often used with the scraper chain conveyor include the feed conveyor, pick-up or extraction conveyor, distribution scraper conveyor (extraction register), cooling conveyor, and soaking tank screen chain. The scraper chain conveyor is also called the chain conveyor, pallet chain conveyor, redler, scraper conveyor, bulk conveyor, chain elevator, and scraper elevator.

Related Machines

- Cable conveyor
- Screw conveyor
- Conveyor belt



Scraper Chain Conveyor

Types

- Central chain conveyor
- Double chain conveyor
- Parallel or multiple chain conveyor
- Cable conveyor
- T-scraper conveyor for horizontal handling
- T or U scraper conveyor for handling product on inclined surfaces
- U or O
- Double O (OO)
- Triple O (OOO) scraper conveyor
- Scraper elevator
- Chain conveyor tight against dust, water, gas, internal depression, or overpressure
- Fully-open bottom conveyor
- Single or double trough conveyor
- Reversible conveyor

Scraper Chain Conveyor Material Handling Machines (continued)

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Downstream Machines

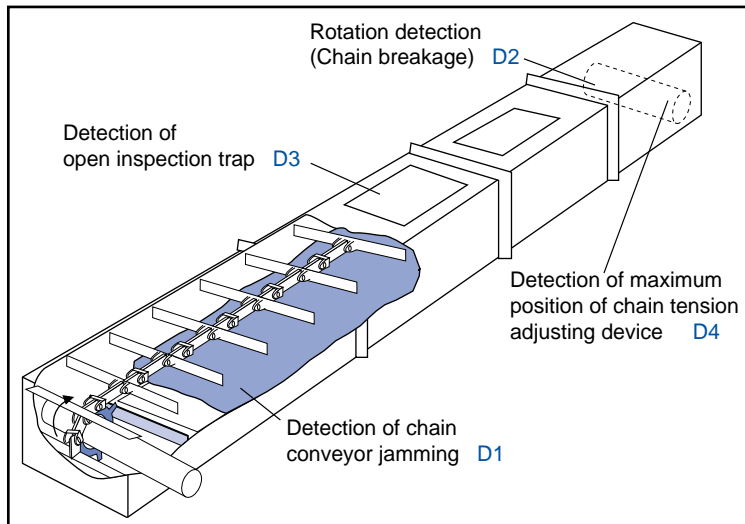
- Silo
- Hopper
- Screw
- Furnace
- Mixer
- Sieve
- Screen
- Crusher
- Granulator plate
- Mill

Upstream Machines

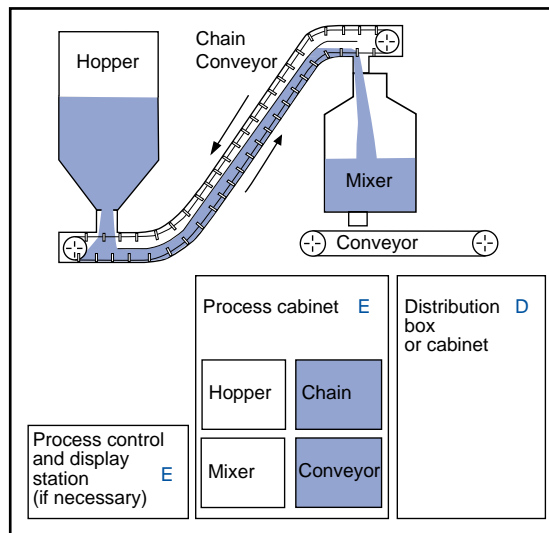
- Silo
- Hopper
- Furnace
- Cleaner
- Separator
- Purifier
- Mixer
- Sieve
- Screen
- Lump breaker

Situation in Environment

The user may expose the chain conveyor to rain, sleet, or snow; operate it at high temperatures, such as ember routing at 800° C; and convey dusty products such as cereals. This electrical equipment is a process sub-assembly incorporated in a common cabinet. Except for the cabinet seal, ventilation, and (if necessary) heating, no recommendations are necessary. Bucket elevator electrical equipment operating alone must comply with strict environmental requirements. Elevating some products, such as sugar or wheat, may generate an explosive atmosphere. In such situations, provide appropriate equipment. Washdown may be required.



Stand-Alone Machine



Machine Located in Process

Electrical Equipment Associated with Scraper Chain Conveyors

The following equipment is associated with scraper chain conveyors:

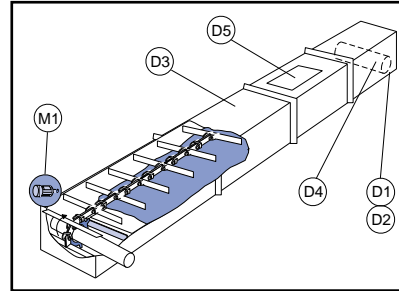
Item	Function	Catalog No. Prefixes*	Qty.
Power Distribution			
D	General distribution	Q0, MG, GS1, GJL, FA, KA, LA, MA	1
D	Mechanical protection of distribution	Enclosures	1
Equipment (process cabinet)			
E	Mechanical protection of equipment	LG, XAP, DE8-B	1
E	Attach electrical equipment	AM1	x†
E	Route cables		x
E	Connect cables	DZ5, ABS, ABE, ABR, 9080 G&M	x
E	Control power supply	9070T/TF	1
Power control (process cabinet)			
E	Chain conveyor energizing	VC, GV, QO, FA, KA, LA	1
E	Movement supply and safety cut-off	LC1, LP1, LP4, SPXLA4, SPXO	1
E/M1	Start motor (if possible on load)	LC1, LP4, LC3, LD1, ATS, ATV, LH4, SPXLA4, SPXO	1
E/M1	Change motor running direction	LC2, LP2, LD5, LP5, ATV	1
E/M1	Change motor speed	LC1, LP1, LP4, ATV, SPXLA4, SPXO	x
E	Energize variable speed controller power	LC1, LP1, LP4, SPXLA4, SPXO	1
E/M1	Variable flow-rate (process initialization or dosing)	ATV	1
Circuit Protection (process cabinet)			
E	Protect motor against short-circuits	GV, LB1L, FA, KA, LA, MA, GJL	1
E	Protect motor against overloads	LR2/9, LT3/6, GV, LB1L, ATV	1
E	Protect control circuit	9080 GCB/FB, GB2CB, GV2, QO, MG	1
E	Protect control power supply transformer	9080 GCB/FB, GB2CB, GV, QO, MG	1
E	Protect process cabinet lighting circuit	9080 GCB/FB, GB2CB, GV2, QO	1
E	Protect conveyor site lighting circuit	9080 GCB/FB, GB2CB, GV2, QO	1
E	Protect 220V power outlet	9080 GCB/FB, GB2CB, GV2, QO	1
E	Protect and monitor network and motor	SM21, EM9T	x
Detection			
D1	Jammed chain conveyor	XC, XSAV, RM3, LR2/9, LT3/6, 9007C/ML/MS, SPXI	1
D2	Chain breakage: end rotation	XSAV	1
D3	Open screw access trap	XC, Safety XC, XCK-J, 9007C/ML/MS, SPXI	1
D4	Chain tension: adjusting device at maximum	XC, 9007C/ML/MS, SDXI	x
	Absence of material passing	XC, XT, 9007C/ML/MS, SPXI	
E	Open electric equipment access door	XCM, XCK, 9007C/ML/MS, SPXI	1
Signaling (dialog)			
E	Voltage present on chain conveyor	XB2B, XA2B, 9001K/SK, SPXKA	1
E	Energize chain conveyor	XB2B, XA2B, 9001K/SK, SPXKA	1
E	Display coded messages, chain conveyor status	ZA2V, XVLA, SPXKM	x
E	Display plain messages, instant flow-rate	XBT	1
E	Display process, exchanges underway	XBT, MMPM	1
E	Reset chain conveyor	XB2B, XA2B, 9001K/SK, SPXKA	1
E	Process supervision	XBT, MMPM, MMFM	1
Control (dialog)/Communication			
E	Start/stop chain conveyor	XBT, XB2B, XA2B, 9001K/SK, SPXKA	1, 2
E	Emergency stop	XB2B, XA2B, 9001K/SK, XPS, XY2-C, VC, XAL	1
E	Select automatic or manual modes	XBT, XB2B, XA2B, 9001K/SK, SPXKA, SPXI	1
E	Manual rotation control (maintenance)	XB2B, XA2B, 9001K/SK, SPXKA, SPXI	2
E	Select desired speed direction	XBT, XB2B, XA2B, 9001K/SK, SPXKA, SPXI	2,1
E	Reset chain conveyor after fault	XBT, XB2B, XA2B, 9001K/SK, SPXKA, SPXI	1
E	Send variable speed controller setpoint	XBT, XB2, SPXAI, TSX07/37	1
	Component networks	SERIPLEX/AS-i	x
Processing			
E	Start order sequence	CA2, CA3, CA4, LA1, 8501K/R, TSX07/37, PCA984	x
E	Time delays	9050 JCK, RE4, RE5, RH, LA2D, LA3D, LA4D, TSX07/37, PCA984	x
E	Power adaptation	RU, RX, RH	x
E	Switch variable speed controller setpoints	CA2, CA3, CA4, LA1, 8501K/R, TSX07/37, PCA984	x
E	Process regulation	TSX37/57, PCA984	1
E	Flow and stock management	TSX57, 140CPU	x
E	Stand-alone machine	TSX07/57, PCA984	1
E	Machine integrated into a process	TSX07, SERIPLEX in unit and TSX37/57, Modicon	x
E/S1	Supervise access trap position switch	XPS-A	1

* Refer to general catalog for full commercial reference.

† Design variable.

**Motor Starter Protection and
Safety Detection**

The illustration and table below provide the protection and safety functions of the recommended products.



	Mark	Qty.	Description	Recommended Product		Remarks
Motor Starter Functions	M1	1	Drives the chain that carries the scrapers: <ul style="list-style-type: none"> • Motor starts on load • Overload information • Flow-rate adaptation 	ATV16 ATV18 ATV66 ATS46	Motor control in a single running direction by type ALTIVAR® 16/18 and ALTIVAR 66 variable speed controllers. ALTISTART 46® soft start controllers may be appropriate for starting a synchronous speed conveyor carrying heavy bulk loads.	If a low power motor is used (P<1.5 kW), a type GV motor protector and manual starter may be used in single speed conveyor applications.
Protection & Safety Functions	S1	1	Sends a stop signal to the motor in an emergency or non-emergency. Restarts by voluntary action.	XPS-AS XU	PREVENTA safety module for type XY2-C trip wire switches. Photo sensor with test input to PREVENTA safety relay.	The conveyor belt may be located close to dangerous zones (e.g., mines, 30 m dock installations). Control units are removed from the intervention spot.
Detection Functions	D1 D2	1	Controls the chain rotation to: <ul style="list-style-type: none"> • Detect material that has jammed • Detect a broken chain 	XSA-V	Type XSA-V inductive sensor for under-speed control (diameter 30 mm, sensing distance 10 mm, setting of under-speed from 50 Hz to 0.1 Hz).	
	D3	>1	Detects the opening of the chain access trap.	XCS	Key-actuated safety position switch type XCS-PL or XCS-TL for rotating covers.	
	D4	1	Detects the chain tension.	XC 9007C/ML/MS	Type XCK-L rectilinear position switch with metal plunger.	Actuated by the intermediate of a mechanical chain tension adjustment device.
	D5	1	Detects the absence of material passing and stops the motor.	XC 9007C/ML/MS	Type XCK-L or XCK-J angular position switch with metal roller.	Actuated by the intermediate of a mechanical device (spring trap or counterweight).

Motor Sizing

The motor sizing of a scraper chain conveyor is:

$$P = \frac{\text{Length} \times 0.33 \times \text{Flow(T/H)}}{100}$$

A scraper chain conveyor with a flow-rate of 50 T/H for flowing material (K=1) requires 7.5 hp power (cable conveyor: 3 hp).

Metric/English Conversions

1 kg = 2.2 pounds
1 tonne = 2200 pounds
1 meter = 3.28 feet
1 kW = 1.34 hp
1 liter = 0.26 gallons

Critical Points

The critical points of a scraper chain conveyor's mechanical performance include:

- Steel-on-steel friction (scrapers against base), which cause wear and generate noise detrimental to the environment (e.g., forged chain not guided by hard plastic heel)
- Chain slack

The critical points of a scraper chain conveyor's electrical performance include detecting the absence of material.

Technological solutions for exchanges between box on machine and process cabinet depend on the topology.

Selection Criteria

To select a scraper chain conveyor, it is important to consider the following:

- Nature of the product.
- Product temperature.
- Type(s) of action and number(s) of material inlets/outlets.
- Flow-rate: several T/H to 800 T/H.
- Related to width of the chain conveyor (150 to 1200 mm) and its linear speed: from 0.1 to 0.7 m/s for horizontal handling and up to 1.2 m/s for handling without bearings (vertical).
- Length of chain conveyor: 2 to 80 meters.
- Resistance to environment: shifted product temperature (800° with water cooling), abrasive product.

As a comparison, a 10 m long, horizontal screw with a flow-rate of 50 T/H of flowing material (K=1) calls for 15 hp (11 kW).

Cost

The price of a scraper chain conveyor 26 meters long with a flow-rate of 100 tonnes per hour is \$9000 before tax.

Delivery and installation increase the price by 30%.

CE Marking

Low voltage directive: 73/23/CEE (February 19, 1973), modified by directive 93/68/CEE (July 22, 1993).

Safety

Safety directives for scraper chain conveyors are addressed in directive No. 89/392/CEE and its associated amendments.

During normal operation, the chain is inaccessible due to encasing.

For maintenance, removable traps with electric locks are installed: position switches monitored by PREVENTA safety modules.

Electromagnetic Compatibility

EMC directives for scraper chain conveyors are addressed in directive 89/336/CEE and its associated amendments.

To reduce harmonic current when a variable speed controller is used, radio interference may need to be attenuated by VW3A input filters with VW3A line coils or SinWave active compensators (MG).